# Atmospheric Radiation Measurement Program

Facilities Newsletter – February 1999

## What's New

The month of March will be busy at the ARM SGP CART site. Several Intensive Observation Period (IOP) experiments will be taking place concurrently. These include the Spring Single-Column Model (SCM) IOP on March 1-21, 1999; the Mini-Shortwave IOP on March 2-14, 1999; the Environmental Technology Laboratory (ETL) Global Positioning System (GPS) Campaign; and the Jet Propulsion Laboratory (JPL)/Airborne Emission Spectrometer (AES) Campaign.

## The ETL GPS Campaign

Participants from the National Oceanic and Atmospheric Administration (NOAA) ETL will be deploying a GPS near the central site to monitor water vapor.

What is a GPS? The first GPS was established about 25 years ago by the U.S. military as a tracking network. The network used orbiting satellites and their predictable paths to link a reference frame to Earth. Today the GPS uses 24 NAVSTAR satellites, which orbit 12,000 miles above Earth and transmit L-band radio signals to ground-based receivers.

A GPS uses the triangulation of signals from the satellites to determine locations on Earth. A ground-based receiver can determine its distance from a satellite by listening to the radio signal sent by the satellite. When the receiver locates its position relative to at least three satellites, it can use mathematical equations to calculate its exact position on Earth to within approximately 100 feet (30 m).

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Recently, GPS has been developed for commercial use, with applications for surveying and mapping, aviation and marine navigation, and tracking vehicles (for example, delivery and transport trucks). GPS receiver costs have decreased in recent years, making the technology affordable to the average consumer. Hand-held GPS receivers are used for navigation in automobiles and also have applications for recreational and outdoor enthusiasts like hikers and boaters.

How does a system that is used primarily for navigation and tracking become useful in measuring water vapor in the atmosphere? Satellite radio signals transmitted to Earth's surface are slowed down as they pass through the atmosphere. The GPS receiver measures delay between the arrival of the satellite signal and the expected arrival time if no intervening atmosphere had been measured. Scientists can isolate the delay caused by the presence of water vapor. From this value, the total precipitable water vapor content can be determined.

Figure 1. GPS antenna installed at Platteville, Colorado.

Water vapor is the most abundant of the greenhouse gases and one of the least understood. It is also important as the material from which clouds and precipitation are formed. Current means for collecting water vapor data include radiosondes, surface-based radiometers, research aircraft, and NOAA weather satellites — the same satellites that gather the cloud images in the daily weather report. Each of these systems has limitations, ranging from data accuracy and frequency to the cost of operation. GPS measurement of water vapor has the potential to provide more accurate and more frequent measurements of atmospheric water vapor content. These two benefits would improve not only global climate modeling, but also daily weather forecasts.